AMENDMENTS TO THE CLAIMS

Please amend the claims as shown in the following listing of the claims.

Claims 2, 3, 5-10, 12, 14 and 16 are withdrawn.

New claim 17 is added.

Claims 1, 4, 11, 13, and 15 are amended.

1. (currently amended) A link mechanism for surgical assist robot to determine a position and direction of an axial rod, comprising:

an axial rod; and

two spherical bearings to support said axial rod, said two spherical bearings being capable of changing positions,

wherein a motion of one of said two spherical bearings relative to said axial rod along an axis of said axial rod is constrained, and the other of said spherical bearings can travel along said rod.

2. (withdrawn) Method to determine a position and a direction of an axial rod of a link mechanism wherein, said link mechanism comprises:

an axial rod; and

two spherical bearings to support said axial rod, said two spherical bearings being capable of changing positions, wherein the method comprises steps of:

constraining a motion of one of said two spherical bearings relative to said axial rod along the axis of said axial rod;

allowing the other of said spherical bearings to travel along said axial rod; and

determining the position and direction of said axial rod by defining a coordinate value of one of said two spherical bearings and a position of the other of said two spherical bearings relative to the one of said two spherical bearings.

3. (withdrawn) A method to determine a position and a direction of an axial rod according to claim 2, wherein the link mechanism is for an output of a robot.

4. (currently amended) A link mechanism for surgical assist robot to determine a position and a direction of an axial rod, comprising:

an axial rod; and

two supports to support said axial rod, said two supports being capable of changing positions,

wherein a motion of one of said two supports relative to said axial rod along an axis of said axial rod is constrained, and the other of said supports can travel along said axial rod.

5. (withdrawn) Method to determine a position and a direction of an axial rod of a link mechanism wherein, said link mechanism comprises:

an axial rod; and

two supports to support said axial rod, said two supports being capable of changing positions,

wherein the method comprises steps of:

constraining a motion of one of said two supports relative to said axial rod along the axis of said axial rod;

allowing the other of said supports to travel along said axial rod; and

determining the position and direction of said axial rod by defining a coordinate value of one of said two supports and a position of the other of said two supports relative to the one of said two supports.

6. (withdrawn) A method to determine a position and a direction of an axial rod according to claim 5, wherein the link mechanism is for an output of a robot.

7. (withdrawn) Method for establishing the position of a second spherical bearing of a link mechanism relative to a first spherical bearing of the mechanism, and for establishing the direction, relative to a rod of the mechanism, of an arm segment extending from said second bearing, the method comprising:

attaching said spherical bearings to said rod, and enabling said two spherical bearings to change positions relative to each other along said rod;

wherein motion of one of said two spherical bearings relative to said rod along an axis of the rod is constrained, and the other of said spherical bearings can travel along said rod; and the method further comprises a step of

defining coordinate values of one of said two spherical bearings and the position of the other of said two spherical bearings relative to the one of said two spherical bearings.

8. (withdrawn) Method according to claim 7, wherein the link mechanism serves as an output of a robot.

9. (withdrawn) Method for establishing the position of a second support of a link mechanism relative to a first support of the mechanism, and for establishing the direction, relative to a rod of the mechanism, of an arm segment extending from said second support, the method comprising:

attaching said supports to said rod, and enabling said two supports to change positions relative to each other along said rod;

wherein motion of one of said two supports relative to said rod along an axis of the rod is constrained, and the other of said supports can travel along said rod; and the method further comprises a step of

defining coordinate values of one of said two supports and the position of the other of said two supports relative to the one of said two supports.

10. (withdrawn) Method according to claim 9, wherein the link mechanism serves as an output of a robot.

11. (currently amended) A link mechanism for surgical assist robot to determine a position and direction of an axial rod of robotic equipment, the link mechanism serving to direct a manipulator of a robot to determine the position and direction of a surgical assist apparatus in the presence of an electromagnetic field of magnetic resonance and therapy equipment, wherein the manipulator has a configuration to minimize magnetic susceptibility and electrical noise radiation, the link mechanism comprising:

an axial rod; and

two spherical bearings engaging with said axial rod, a second bearing of said two spherical bearings being capable of changing positions relative to ~~each other~~ a first bearing of said two spherical bearings along said axial rod, wherein said robot has a first manipulator extending from ~~a~~ said first of said spherical bearings and a second manipulator extending from ~~a~~ said second of said spherical bearings to engage the surgical assist apparatus while minimizing interaction with said electromagnetic field; and

wherein a motion of said first spherical bearing relative to said axial rod along an axis of said axial

rod is constrained, and said second spherical bearing can travel along said rod to enable a drive mechanism of the robot to position and to direct each of said first and said second manipulators.

12. (withdrawn) A method to determine a position and a direction of an axial rod of a link mechanism in robotic equipment, the link mechanism serving to direct a manipulator of a robot to determine the position and direction of a surgical assist apparatus in the presence of an electromagnetic field of magnetic resonance and therapy equipment, wherein the manipulator has a configuration to minimize magnetic susceptibility and electrical noise radiation, the manipulator comprising:

an axial rod; and

two spherical bearings engaging with said axial rod, said two spherical bearings being capable of changing positions relative to each other along said axial rod, wherein said robot has a first manipulator extending from a first of said spherical bearings and a second manipulator extending from a second of said spherical bearings to engage the surgical assist apparatus while minimizing interaction with said electromagnetic field, wherein the method comprises steps of:

constraining a motion of one of said two spherical bearings relative to said axial rod along the axis of said axial rod;

allowing the other of said spherical bearings to travel along said rod to enable a drive mechanism of the robot to position and to direct each of said first and said second manipulators; and

determining the position and the direction of said axial rod by defining a coordinate value of one of said two spherical bearings and a position of the other of said two spherical bearings relative to the one of said two spherical bearings.

13. (currently amended) A link mechanism <u>for surgical assist robot</u> to determine a <u>position having coordinates</u> (X_1, Y_1, Z_1) ~~position~~ and <u>a</u> direction <u>having coordinates</u> (θ, φ) of an axial rod (R) for robotic equipment works in the robotic workspace, the link mechanism comprising:

an axial rod (R); and

two spherical bearings (P_1 and P_2) engaging with said axial rod (R), said first spherical bearing (P_1) ~~being capable of changing~~ <u>having said</u> position <u>coordinates</u> ~~into~~ (X_1, Y_1, Z_1)<u>,</u> and said second spherical bearing (P_2) being capable of changing <u>its</u> ~~positions~~ <u>position identified by</u>

coordinates ~~into~~ ~~(X', Y', Z')~~ (x', y', z') derived from an equation (1) relative to said first spherical bearing (P_1) along said axial rod (R), wherein

$$x' = r \cos \varphi \sin \theta$$
$$y' = r \sin \varphi \sin \theta$$
$$z' = r \cos \theta \qquad (1)$$

wherein said first spherical bearing (P_1) ~~being~~ is capable of being driven to change position of the rod in three-dimensional ~~in 3D~~ space by a driver and said second spherical bearing (P_2) ~~being~~ is capable of being driven to change position in ~~3D~~ three dimensional space or ~~2D~~ a two dimensional plane relative to said first spherical bearing (P_1) by a driver, said robot has said robotic equipment mounted on said axial rod (R); and the length of the axial rod (R) should be longer than the maximum length of r, and

wherein a motion of said first spherical bearing (P_1) relative to said axial rod (R) along of said axial rod (R) is constrained, and said second spherical bearing (P_2) can travel along said axial rod (R) to enable to position and to direct said axial rod (R) and said robotic equipment,

wherein:

r: distance between [[p_1]] P_1 and P_2 along the axis of axial rod (R)

x_2: coordinate value of P_2 along the x axis of xyz coordinate

y_2: coordinate value of P_2 along the y axis of xyz coordinate

z_2: coordinate value of P_2 along the z axis of xyz coordinate

x_1: coordinate value of P_1 along the x axis of xyz coordinate

y_1: coordinate value of P_1 along the y axis of xyz coordinate

z_1: coordinate value of P_1 along the z axis of xyz coordinate

θ: angle of R measured from x axis of x-z plane

Φ: angle of R measured from y axis of y-z plane

$x' = x_2 - x_1$

$y' =$ [[Y_2-Y_1]] $\underline{y_2 - y_1}$

$z' = z_2 - z_1$

$r^2 = x'^2 + y'^2 + z'^2$

14. (withdrawn) A method to determine a position (X_1, Y_1, Z_1) and direction (θ, φ)) of an axial rod (R) for robotic equipment works in the robotic workspace, the link mechanism comprising:

an axial rod (R); and

two spherical bearings (P_1 and P_2) engaging with said axial rod (R), said first spherical bearing (P_1) being capable of changing position into (X_1, Y_1, Z_1) and said second spherical bearing (P_2) being capable of changing position into(X', Y', Z') derived from equation (1) relative to said first spherical bearing (P_1) along said axial rod (R),

$$x' = r \cos \varphi \sin \theta$$

$$y' = r \sin \varphi \sin \theta$$

$$z' = \cos \theta \qquad (1)$$

wherein said first spherical bearing (P_1) being capable of being driven to change position in 3D space by driver and said second spherical bearing (P_2) being capable of being driven to change position in 3D space or 2D plane relative to said first spherical beating (P_1) by driver, said robot has said robotic equipment mounted on said axial rod (R); and the length of the axial rod (R) should be longer than the maximum length of r, and

wherein a motion of said first spherical bearing (P_1) relative to said axial rod (R) along of said axial rod (R) is constrained, and said second spherical bearing (P_2) can travel along said axial rod (R) to enable to position and to direct said axial rod (R) and said robotic equipment,

Wherein:

r: distance between p_1 and P2 along the axis of axial rod (R)

x_2: coordinate value of P_2 along the x axis of xyz coordinate

y_2: coordinate value of p_2 along the y axis of xyz coordinate

z_2: coordinate value of p_2 along the z axis of xyz coordinate

x_1: coordinate value of p_1 along the x axis of xyz coordinate

y_1: coordinate value of p_1 along the y axis of xyz coordinate

z_1: coordinate value of p_1 along the z axis of xyz coordinate

θ: angle of R measured from x axis of x-z plane

Φ: angle of R measured from y axis of y-z plane

$x' = x_2 - x_1$

$Y' = Y_2 - Y_1$

$z' = z_2 - z_1$

$r^2 = x'^2 + y'^2 + z'^2$

15. (currently amended) A link mechanism for surgical assist robot to determine a position having coordinates (X_1, Y_1, Z_1) and a direction having coordinates (θ, φ) of an axial rod (R) for robotic equipment works in the robotic workspace, the link mechanism comprising:

an axial rod (R); and

two supports (P_1 and P_2) engaging with said axial rod (R), said first support (P_1) ~~being capable of changing~~ having said position coordinates ~~into~~ (X_1, Y_1, Z_1) and said second support (P_2) being capable of changing its position identified by coordinates (x', y', z') ~~into(X', Y', Z')~~ derived from an equation (1) relative to said first support (P_1) along said axial rod (R), wherein

$$x' = r \cos \varphi \sin \theta$$

$$y' = r \sin \varphi \sin \theta$$

$$z' = r \cos \theta \qquad (1)$$

wherein said first support (P_1) ~~being~~ is capable of being driven to change position of the rod in three-dimensional ~~in 3D~~ space by a driver and said second support (P_2) ~~being~~ is capable of being driven to change position in ~~3D~~ three dimensional space or a two dimensional ~~2D~~ plane relative to said first support (P_1) by a driver, said robot has said robotic equipment mounted on said axial rod (R); and the length of the axial rod (R) should be longer than the maximum length of r, and

wherein a motion of said first support (P_1) relative to said axial rod (R) along of said axial rod (R) is constrained, and said second support (P_2) can travel along said axial rod (R) to enable to position and to direct said axial rod (R) and said robotic equipment,

Wherein:

r: distance between [[p_1]] $\underline{P_1}$ and P_2 along the axis of axial rod (R)

x_2: coordinate value of P_2 along the x axis of xyz coordinate

y_2: coordinate value of P_2 along the y axis of xyz coordinate

z_2: coordinate value of P_2 along the z axis of xyz coordinate

x_1: coordinate value of P_1 along the x axis of xyz coordinate

y_1: coordinate value of P_1 along the y axis of xyz coordinate

z_1: coordinate value of P_1 along the z axis of xyz coordinate

θ: angle of R measured from x axis of x-z plane

Φ: angle of R measured from y axis of y-z plane

$x' = x_2 - x_1$

$y' = y_2 - y_1$

$z' = z_2 - z_1$

$r^2 = x'^2 + y'^2 + z'^2$

16. (withdrawn) A method to determine a position (X_1, Y_1, Z_1,) and direction (θ, φ) of an axial rod (R) for robotic equipment works in the robotic workspace, the link mechanism comprising:

an axial rod (R); and

two supports (P_1 and P_2) engaging with said axial rod (R), said first supp›rt (P_1) being capable of changing position into (X_1, Y_1, Z_1,) and said second support (P_2) being capable of changing position into(X', Y', Z') derived from equation (1) relative to said first support (P_1) along said axial rod (R),

$$x' = r \cos \varphi \sin \theta$$

$$y' = r \sin \varphi \sin \theta$$

$$z' = r \cos \theta \qquad (1)$$

wherein said first support (P_1) being capable of being driven to change position in 3D space by driver and said second support (P_2) being capable of being driven to change position in 3D space or 2D plane relative to said first support (P_1) by driver, said robot has said robotic equipment mounted on said axial rod (R); and the length of the axial rod (R) should be longer than the maximum length of r, and

wherein a motion of said first support (P_1) relative to said axial rod (R) along of said axial rod (R) is constrained, and said second support (P_2) can travel along said axial rod (R) to enable to position and to direct said axial rod (R) and said robotic equipment,

wherein:

r: distance between p_1 and P2 along the axis of axial rod (R)

x_2: coordinate value of P_2 along the x axis of xyz coordinate

y_2: coordinate value of p_2 along the y axis of xyz coordinate

z_2: coordinate value of p_2 along the z axis of xyz coordinate

x_1: coordinate value of p_1 along the x axis of xyz coordinate

y_1: coordinate value of p_1 along the y axis of xyz coordinate

z_1: coordinate value of p_1 along the z axis of xyz coordinate

θ: angle of R measured from x axis of x-z plane

Φ: angle of R measured from y axis of y-z plane

$x' = x_2 = x_1$

$Y' = Y_2 - Y_1$

$z' = z_2 - z_1$

$r^2 = x'^2 + y'^2 + z'^2$

17. (new) Robotic apparatus comprising a link mechanism with a first manipulator and a second manipulator connected to the link mechanism to determine the position and direction of a surgical assist apparatus in the presence of an electromagnetic field of magnetic resonance and therapy equipment, wherein each of said manipulators has a configuration to minimize magnetic susceptibility and electrical noise radiation, the link mechanism comprising:

an axial rod; and

two spherical bearings engaging with said axial rod, a second bearing of said two spherical bearings being capable of changing positions relative to a first bearing of said two spherical bearings along said axial rod, wherein said first manipulator extends from said first of said spherical bearings and said second manipulator extends from said second of said spherical bearings to engage the surgical assist apparatus while minimizing interaction with said electromagnetic field; and

wherein a motion of said first spherical bearing relative to said axial rod along an axis of said axial rod is constrained, and said second spherical bearing can travel along said rod to enable a drive mechanism to position and to direct each of said first and said second manipulators.